# Data augmentation for deep-learning-based electroencephalography

Year: 2020 | Citations: 309 | Authors: Elnaz Lashgari, Dehua Liang, U. Maoz

---

## Abstract

BACKGROUND

Data augmentation (DA) has recently been demonstrated to achieve considerable performance gains for deep learning (DL)-increased accuracy and stability and reduced overfitting. Some electroencephalography (EEG) tasks suffer from low samples-to-features ratio, severely reducing DL effectiveness. DA with DL thus holds transformative promise for EEG processing, possibly like DL revolutionized computer vision, etc. NEW METHOD: We review trends and approaches to DA for DL in EEG to address: Which DA approaches exist and are common for which EEG tasks? What input features are used? And, what kind of accuracy gain can be expected?

RESULTS

DA for DL on EEG begun 5 years ago and is steadily used more. We grouped DA techniques (noise addition, generative adversarial networks, sliding windows, sampling, Fourier transform, recombination of segmentation, and others) and EEG tasks (into seizure detection, sleep stages, motor imagery, mental workload, emotion recognition, motor tasks, and visual tasks). DA efficacy across techniques varied considerably. Noise addition and sliding windows provided the highest accuracy boost; mental workload most benefitted from DA. Sliding window, noise addition, and sampling methods most common for seizure detection, mental workload, and sleep stages, respectively.

COMPARING WITH EXISTING METHODS

Percent of decoding accuracy explained by DA beyond unaugmented accuracy varied between 8% for recombination of segmentation and 36% for noise addition and from 14% for motor imagery to 56% for mental workload-29% on average.

CONCLUSIONS

DA increasingly used and considerably improved DL decoding accuracy on EEG. Additional publications-if adhering to our reporting guidelines-will facilitate more detailed analysis.